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Genetic analysis of parameters of near earth asteroids for determining parent bodies of meteoroid streams

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Abstract

The present paper is focusing on determining genetic connections between small bodies of the Solar system and their parent bodies (PB) on the basis of analysis of Near Earth Asteroids (NEAs) parameters. In order to search for parent bodies of meteoroid streams, the asteroid groups, including Atira, Apollo, Amor and Aten, have been investigated. Currently, it is considered that surface of asteroids with elongated orbit is exposed to temperature fall: in perihelion it is heated and in aphelion it is cooled. At small orbital periods around the Sun (about 2–4 years) this may lead to formation of meteoroid clusters. On the basis of comparative analysis of orbit, size and chemical and mineralogical composition of NEAs, it is found that asteroids from Apollo group are most likely to be parent bodies of the studied meteoroid streams.

Keywords: Asteroids; Meteoroid streams; Small bodies of the solar system; The orbits evolution

1. Introduction

Currently, structural composition of meteoroid streams (luminosity function parameter, which describes the distribution of meteoroids over stellar magnitudes (Bel'kovich and Ishmukhametova, 2010), distribution of meteoroids for mass in stream, zenithal hourly rate and space density of streams in its cross-section along the Earth's orbit) (Sokolova et al., 2014, 2016) as well as questions of genetic connection of observed small space bodies (meteoroids, comets, asteroids) are being actively studied. With this purpose, the method of D_{SH}-criterion (introduced by Southworth and Hawkins (1963) and Drummond (1981) modified this method and created a new one. Recent updates can be found in Jopek et al. (2008) and Rudawska et al. (2015)) is used as a measure of dynamic closeness of the distances between bodies' orbits in five-dimensional phase space. When analyzing genetic connections of cometary and meteoroid systems, the value of D_{SH}-criterion is considered to be 0.2 for all meteoroid streams. For more reliable estimation the upper bound of D_{SH}-criterion is studied for each meteoroid cluster as it was carried out in case of the Taurids meteoroid stream (Porubcan et al., 2006). Recently, the study of genetic connections between meteoroid streams and Near Earth Asteroids (NEAs) has become an important direction of research. The majority of asteroids (more than 98%) are concentrated in the asteroid belt (between the orbits of Mars and Jupiter), the Kuiper belt (behind the orbit of Neptune), and the Oort cloud (at the external border of the Solar system). From time to time some of these objects change their orbits under the influence of gravitation from larger celestial bodies and may pose a danger to the Earth. On the other hand, passage of a spacecraft through meteoroid streams (meteoroids similarly orbiting) could

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